

## SECTION E SCOTTISH MORTALITY AUDIT RENAL REPLACEMENT THERAPY (SMARRT)

Data regarding all deaths of adult patients receiving RRT in Scotland are submitted to the SRR via the Scottish Mortality Audit of Renal Replacement Therapy (SMARRT). Cause and contributors to death as well as location of death are recorded. In addition, the clinicians responsible for a patient's care are asked to comment on the presence or absence of areas of clinical concern in patient management prior to death.

A five point scale is used:

1. **There were no areas of concern or for consideration in the management of this patient**
2. **There were areas for consideration but they made no difference to the eventual outcome**
3. **There were areas of concern but they made no difference to the eventual outcome**
4. **There were areas of concern which may have contributed to this patient's death**
5. **There were areas of concern which CAUSED the death of this patient who would have been expected to survive**

Those deaths classed as category 4 or 5 are further assessed through a process which may include a review of case note records, discussion at local morbidity and mortality meetings, critical incident review reports or procurator fiscal reports. From analysis of this additional information several recurring themes have emerged.

These themes are:

- **Hyperkalaemia**

Death due to hyperkalaemic arrest. Patient non-concordance with treatment is noted to contribute in >50% of cases.

- **Prescribing**

Death attributed to adverse drug effects - inappropriate drug choices, combinations or monitoring. Most cases involve the use of common drugs including antiplatelet agents/ anticoagulants, opioid analgesics or immunosuppressant medication.

- **Systems of care**

Deaths attributed to failures of communication, inadequate out of hours cover, delays in specialist renal input or inadequate staff training.

- **Infection**

Deaths attributed to severe infection due to delays in its recognition or management, sepsis in the context of immunosuppressive drugs or due to vascular access related infection.

- **Vascular Access**

Deaths attributed to complications of vascular access. Examples include fatal blood loss (intentional and accidental), inadequate dialysis following failure to address poor vascular access or cardiovascular compromise from AVF formation.

## ● Interventions

Deaths attributed as a direct consequence of an operation or procedure. Examples include recognised bleeding complications of angiography and viscus perforation during endoscopic procedures.

## ● Other

Deaths following a fall-related fracture, unexpected deterioration during dialysis or noncompliance.

<b>E1 Categories of deaths by year 2008-2017</b>												
Year	Cat 1		Cat 2		Cat 3		Cat 4		Cat 5		Missing	
	n	%	n	%	n	%	n	%	n	%	n	%
2008-2012	1806	<b>83.5</b>	228	<b>10.5</b>	38	<b>1.8</b>	71	<b>3.3</b>	12	<b>0.6</b>	9	<b>0.4</b>
2013	350	<b>78.1</b>	56	<b>12.5</b>	20	<b>4.5</b>	15	<b>3.3</b>	6	<b>1.3</b>	1	<b>0.2</b>
2014	336	<b>78.0</b>	42	<b>9.7</b>	21	<b>4.9</b>	23	<b>5.3</b>	6	<b>1.4</b>	3	<b>0.7</b>
2015	353	<b>76.7</b>	62	<b>13.5</b>	25	<b>5.4</b>	15	<b>3.3</b>	3	<b>0.7</b>	2	<b>0.4</b>
2016	370	<b>78.9</b>	62	<b>13.2</b>	23	<b>4.9</b>	11	<b>2.3</b>	1	<b>0.2</b>	2	<b>0.4</b>
2017	369	<b>75.6</b>	67	<b>13.7</b>	18	<b>3.7</b>	17	<b>3.5</b>	4	<b>0.8</b>	13	<b>2.7</b>
<b>Total</b>	<b>3584</b>	<b>80.4</b>	<b>517</b>	<b>11.6</b>	<b>145</b>	<b>3.3</b>	<b>152</b>	<b>3.4</b>	<b>32</b>	<b>0.7</b>	<b>30</b>	<b>0.7</b>

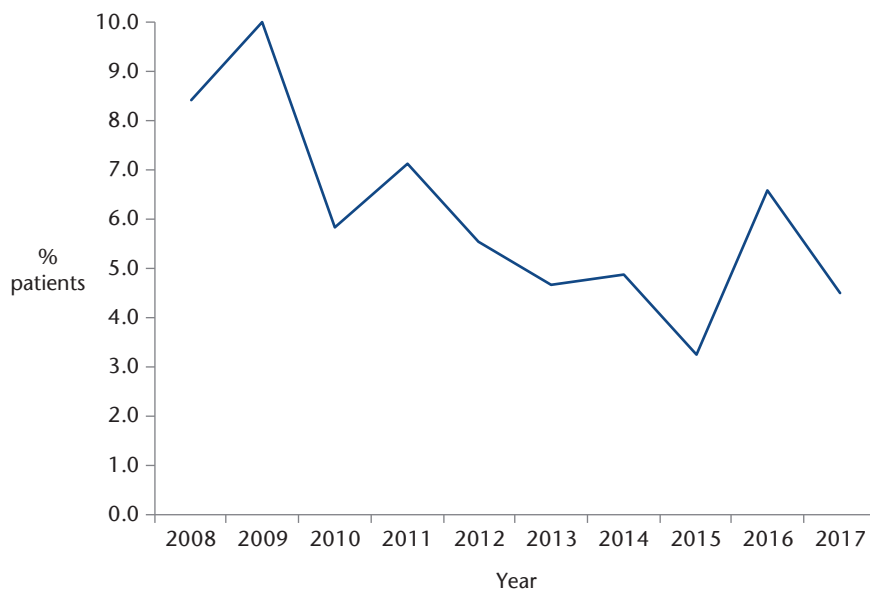
<b>E2 Themes of category 4 and 5 deaths by year 2008- 2017</b>															
Year	Hyper-kalaemia		Prescribing		Systems of Care		Infection		Vascular Access		Intervention		Other		Total
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	
2008-2012	4	<b>4.8</b>	13	<b>15.7</b>	19	<b>22.9</b>	28	<b>33.7</b>	10	<b>12.0</b>	7	<b>8.4</b>	2	<b>2.4</b>	<b>83</b>
2013	2	<b>9.5</b>	0	<b>0.0</b>	9	<b>42.9</b>	3	<b>14.3</b>	1	<b>4.8</b>	4	<b>19.0</b>	2	<b>9.5</b>	<b>21</b>
2014	0	<b>0.0</b>	0	<b>0.0</b>	7	<b>24.1</b>	11	<b>37.9</b>	5	<b>17.2</b>	2	<b>6.9</b>	4	<b>13.8</b>	<b>29</b>
2015	0	<b>0.0</b>	4	<b>22.2</b>	5	<b>27.8</b>	6	<b>33.3</b>	0	<b>0.0</b>	1	<b>5.6</b>	2	<b>11.1</b>	<b>18</b>
2016	1	<b>8.3</b>	1	<b>8.3</b>	2	<b>16.7</b>	6	<b>50.0</b>	0	<b>0.0</b>	0	<b>0.0</b>	2	<b>16.7</b>	<b>12</b>
2017	2	<b>9.5</b>	1	<b>4.8</b>	6	<b>28.6</b>	7	<b>33.3</b>	4	<b>19.0</b>	0	<b>0.0</b>	1	<b>4.8</b>	<b>21</b>
<b>Total</b>	<b>9</b>	<b>4.9</b>	<b>19</b>	<b>10.3</b>	<b>48</b>	<b>26.1</b>	<b>61</b>	<b>33.2</b>	<b>20</b>	<b>10.9</b>	<b>14</b>	<b>7.6</b>	<b>13</b>	<b>7.1</b>	<b>184</b>

**E3 Location of death by year 2008-2017**

Year	Usual Residence		Hospital		Hospice		Community Hospital		Other		Unknown		Missing	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%
2008-2012	468	<b>21.6</b>	1489	<b>68.8</b>	46	<b>2.1</b>	49	<b>2.3</b>	35	<b>1.6</b>	19	<b>0.9</b>	58	<b>2.7</b>
2013	98	<b>21.9</b>	317	<b>70.8</b>	11	<b>2.5</b>	13	<b>2.9</b>	5	<b>1.1</b>	2	<b>0.4</b>	2	<b>0.4</b>
2014	85	<b>19.7</b>	303	<b>70.3</b>	17	<b>3.9</b>	10	<b>2.3</b>	3	<b>0.7</b>	0	<b>0.0</b>	13	<b>3.0</b>
2015	105	<b>22.8</b>	299	<b>65.0</b>	17	<b>3.7</b>	16	<b>3.5</b>	3	<b>0.7</b>	1	<b>0.2</b>	19	<b>4.1</b>
2016	101	<b>21.5</b>	310	<b>66.1</b>	21	<b>4.5</b>	11	<b>2.3</b>	4	<b>0.9</b>	1	<b>0.2</b>	21	<b>4.5</b>
2017	115	<b>23.6</b>	322	<b>66.0</b>	18	<b>3.7</b>	5	<b>1.0</b>	0	<b>0.0</b>	0	<b>0.0</b>	28	<b>5.7</b>
<b>Total</b>	<b>972</b>	<b>21.8</b>	<b>3040</b>	<b>68.2</b>	<b>130</b>	<b>2.9</b>	<b>104</b>	<b>2.3</b>	<b>50</b>	<b>1.1</b>	<b>23</b>	<b>0.5</b>	<b>141</b>	<b>3.2</b>

**E4 Factors contributing to death 2008-2017**

Year	With-drawal		Access failure/ infection		Dialysis complications		Non-compliance		Peritoneal Infection		Trans-plant Complication		Health-care Associated Infection		Malignancy		Missing	
	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%	n	%
2008-2012	677	<b>31.3</b>	191	<b>10.6</b>	117	<b>6.5</b>	88	<b>4.9</b>	60	<b>3.3</b>	126	<b>7.0</b>	170	<b>9.4</b>	349	<b>19.3</b>	32	<b>1.8</b>
2013	161	<b>35.9</b>	24	<b>6.2</b>	23	<b>6.0</b>	21	<b>5.4</b>	13	<b>3.4</b>	32	<b>8.3</b>	30	<b>7.8</b>	77	<b>19.9</b>	5	<b>1.3</b>
2014	147	<b>34.1</b>	32	<b>8.3</b>	19	<b>4.9</b>	24	<b>6.2</b>	11	<b>2.9</b>	35	<b>9.1</b>	28	<b>7.3</b>	80	<b>20.8</b>	9	<b>2.3</b>
2015	170	<b>37.0</b>	36	<b>8.8</b>	18	<b>4.4</b>	10	<b>2.5</b>	9	<b>2.2</b>	41	<b>10.1</b>	26	<b>6.4</b>	89	<b>21.9</b>	8	<b>2.0</b>
2016	163	<b>34.8</b>	21	<b>5.7</b>	23	<b>6.3</b>	21	<b>5.7</b>	8	<b>2.2</b>	24	<b>6.5</b>	20	<b>5.4</b>	83	<b>22.6</b>	5	<b>1.4</b>
2017	193	<b>39.5</b>	28	<b>6.5</b>	24	<b>5.6</b>	20	<b>4.6</b>	10	<b>2.3</b>	24	<b>5.6</b>	30	<b>6.9</b>	83	<b>19.2</b>	20	<b>4.6</b>
<b>Total</b>	<b>1511</b>	<b>33.9</b>	<b>332</b>	<b>8.8</b>	<b>224</b>	<b>5.9</b>	<b>184</b>	<b>4.9</b>	<b>111</b>	<b>2.9</b>	<b>282</b>	<b>7.4</b>	<b>304</b>	<b>8.0</b>	<b>761</b>	<b>20.1</b>	<b>79</b>	<b>2.1</b>

**E5 Proportion of patients who died within 90 days of starting RRT 2008-2017**

Percentage of patients who die at  $\leq 90$  days after commencing any form of RRT per year 2008-2017,  $p < 0.001$  for trend.

## E6 Review of SMARRT

This year (2018) marks the 10th anniversary of the inception of SMARRT, and therefore provides an opportunity to reflect on the success of the audit and look forward to how it might evolve over the next ten years. Around 2007, the SRR highlighted between centre variation in the outcomes for those receiving RRT. In order to investigate this, granular data were needed and SMARRT began collecting data the following year.

The nephrology community of Scotland have strongly supported the aims of SMARRT with 4460 individual forms completed to the end of 2017 and >99% completeness. The process has evolved over the years and the allocation of the category of concern is now assigned by the multi-professional renal team at local Morbidity and Mortality meetings and reported to SMARRT.

The audit has led to significant contributions to the literature regarding vascular access type and cause of death<sup>1</sup>, adverse events and subsequent mortality<sup>2</sup> and withdrawal from RRT<sup>3</sup>. In addition, seven abstracts have been presented at national and international meetings to broad audiences.

During this 10-year period there have been changes in the legal framework in which healthcare professionals operate, notably the introduction of Duty of Candour legislation. In addition, the demographics of the RRT population have changed with increasing levels of frailty and how we provide conservative kidney management has evolved over the decade to reflect this. Therefore SMARRT must also evolve to remain relevant to its original aims and continue to collect high quality data to ensure we identify areas where safety can be improved. This is a priority for the SMARRT group.

In this era of financial constraints and workload pressures it is a testament to the renal community's drive to provide outstanding care, that commitment to SMARRT remains strong and we would like to thank everyone who has contributed to SMARRT in the past 10 years.

### References:

- 1 B D Bray et al., "Vascular Access Type and Risk of Mortality in a National Prospective Cohort of Haemodialysis Patients.," QJM : Monthly Journal of the Association of Physicians 105, no. 11 (November 1, 2012): 1097–1103, doi:10.1093/qjmed/hcs143.
- 2 Benjamin D Bray et al., "How Safe Is Renal Replacement Therapy? A National Study of Mortality and Adverse Events Contributing to the Death of Renal Replacement Therapy Recipients.," Nephrology, Dialysis, Transplantation : Official Publication of the European Dialysis and Transplant Association - European Renal Association 29, no. 3 (March 1, 2014): 681–87, doi:10.1093/ndt/gft197.
- 3 Mark D. Findlay et al., "Factors Influencing Withdrawal from Dialysis: A National Registry Study," Nephrology Dialysis Transplantation 31, no. 12 (2016): 2041–48, doi:10.1093/ndt/gfw074.